CLAIMS:

1. A method of parametrically encoding a transient audio signal, the method comprising:

(a) determining a set of frequency values V for N largest frequency components of the transient audio signal, where N is a predetermined number;

(b) determining an approximate envelope of the transient audio signal; and

(c) determining a predetermined number P of amplitude values W of samples of the approximate envelope for use in generating a spline approximation of the approximate envelope;

whereby a parametric representation of the transient audio signal is given by parameters including V, N, P and W, such that a decoder receiving the parametric representation can reproduce a decoder approximation of the transient audio signal.

2. The method of claim 1, further comprising:

(a) generating a spline approximation of the approximate envelope using a spline interpolation function and the amplitude values W;

(b) generating an encoder approximation of the transient audio signal based on the spline approximation, the set of frequency values V, the number N, the number P and the amplitude values W;

(c) determining energy levels of the encoder approximation and the transient audio signal, respectively; and

(d) determining a scaling factor as a function of the energy levels of the encoder approximation and the transient audio signal for scaling the decoder approximation with the energy level of the transient audio signal.

3. The method of claim 1, further comprising transmitting the parametric representation of the transient audio signal via a communication medium.

4. The method of claim 2, wherein the spline interpolation function is a cubic spline interpolation function.

5. The method of claim 1, wherein N is determined according to a bit rate of an audio encoder performing the method.

6. The method of claim 1, wherein step (a) includes:

determining a set of frequency components of the transient audio signal by performing a fast Fourier transform thereof, and

selecting N largest frequency components of the set of determined frequency components.

7. The method of claim 1, further comprising determining an interval, I, of the transient audio signal and wherein the parameters of the parametric representation further include the interval I.

8. The method of claim 7, wherein the samples W are equally spaced in time over the interval I.

9. The method of claim 1, wherein a received approximation of the transient audio signal x[n] is given by:

$$\hat{x}[n] = \sum_{k \in V} \left(real(X[k]) \cos\left(\frac{2\pi nk}{I}\right) - imag(X[k]) \sin\left(\frac{2\pi nk}{I}\right) \right)$$

where X[k] are frequency coefficients of x[n] for k=1, 2, …, N; and

I is the interval of the transient audio signal.

10. The method of claim 1, wherein step (b) includes:

determining an absolute value version $x_{abs}[n]$ of the transient audio signal $x[n]$; and

low-pass filtering the absolute value version $x_{abs}[n]$ to generate the approximate envelope $x_{env}[n]$.

11. An encoder, the encoder comprising:

means for determining a set of frequency values V for N largest frequency components of a transient audio signal, where N is a predetermined number;

means for determining an approximate envelope of the transient audio signal; and

means for determining a predetermined number P of amplitude values W of samples of the approximate envelope for use in generating a spline approximation of the approximate envelope.

12. A decoder, the decoder comprising:

means for extracting a set of frequency values V for N largest frequency components from an encoded transient audio signal, where N is a predetermined number; and

means for extracting an approximate envelope from the encoded transient audio signal.

13. A method of decoding a parametrically encoded signal, the method comprising:

(a) receiving a parametric representation of the signal, the parametric representation including a set of frequency values V for a predetermined number N frequency components of the signal and a set of amplitude values W; and

(b) reproducing a decoder approximation of the encoded signal according to the parametric representation by:

1) generating a sinusoidal signal by combining the set of frequency values V of the N frequency components of the transient audio signal;

2) generating a spline approximation using a spline interpolation function and the set of amplitude values W; and

3) applying the spline approximation to the sinusoidal signal.

14. The method of claim 13, wherein the parametric representation includes a scaling factor and the method of decoding further comprises:

(c) scaling an energy level of the decoder approximation according to the scaling factor to match the energy level of the transient audio signal.

15. A decoder, the decoder comprising:

means for receiving a parametric representation of a transient audio signal, the parametric representation including a set of frequency values V for a predetermined number N frequency components of the transient audio signal and a set of amplitude values W; and

means for reproducing a decoder approximation of the transient audio signal according to the parametric representation, the means for reproducing a decoder approximation including:

means for generating a sinusoidal signal by combining the set of frequency values V of the N frequency components of the transient audio signal;

means for generating a spline approximation using a spline interpolation function and the set of amplitude values W; and

means for applying the spline approximation to the sinusoidal signal.

16. A system for parametrically encoding a transient audio signal, the system comprising:

means for determining a set of frequency values V of N largest frequency components of the transient audio signal, where N is a predetermined number;

means for determining an approximate envelope of the transient audio signal;

means for determining a predetermined number P of amplitude values W of samples of the approximate envelope for use in generating a spline approximation of the approximation envelope;

means for transmitting a parametric representation of the transient audio signal comprising a set of parameters, the parameters including V, N, P and W, such that a decoder receiving the parametric representation can reproduce a decoder approximation of the transient audio signal.

17. A signal encoder, the encoder comprising:

a sinusoidal component estimator for estimating a set of values V for a number N of sinusoidal components of a signal;

a sinusoidal component quantifier coupled to the sinusoidal component estimator;

a signal envelope estimator for generating an estimated signal envelope of the signal and a set of values W for a number P of samples of the estimated signal envelope;

a signal envelope quantifier coupled to the signal envelope parameter estimator; and

a multiplexer coupled to the sinusoidal component quantifier and the signal envelope quantifier for generating an encoded data stream, the encoded data stream including the values V and W.

18. The encoder of claim 17 wherein the signal envelope estimator determines an energy scaling factor.

19. A system for transmitting a signal, the system comprising:

an encoder that includes:

a sinusoidal component estimator for estimating a set of values V for a number N of sinusoidal components of the signal;

a sinusoidal component quantifier coupled to the sinusoidal component estimator;

a signal envelope estimator for generating an estimated signal envelope and a set of values W for a number P of samples of the estimated signal envelope;

a signal envelope quantifier coupled to the signal envelope parameter estimator; and

a multiplexer coupled to the sinusoidal component quantifier and the signal envelope quantifier for generating an encoded data stream, the encoded data stream including the sets of values V and W; and

a decoder that includes:

a demultiplexer for demultiplexing the encoded data stream;

a sinusoidal component decoder for generating a reconstructed sinusoidal component of a decoded signal using the set of values V and the number N;

a signal envelope reconstruction module for generating a reconstructed signal envelope for the decoded signal using the set of values W and the number P; and

a recomposition module coupled to the sinusoidal component decoder and the signal envelope reconstruction module for generating a decoded signal.

20. A method of encoding a signal, the method comprising:

(a) determining a set of frequency values V for N frequency components of the signal, where N is a predetermined number;

(b) determining an approximate envelope of the signal; and

(c) determining a predetermined number P of amplitude values W of samples of the approximate envelope.

21. The method of claim 20, further comprising:

(a) generating a spline approximation of the approximate envelope using a spline interpolation function and the amplitude values W;

(b) generating an encoder approximation of the signal based on the spline approximation, the set of frequency values V, the number N, the number P and the amplitude values W;

(c) determining energy levels of the encoder approximation and the signal, respectively; and

(d) determining a scaling factor as a function of the energy levels of the encoder approximation and the signal.

22. The method of claim 21, wherein the spline interpolation function is a cubic spline interpolation function.

23. The method of claim 20, wherein step (a) includes:

determining a set of frequency components of the signal by performing a fast Fourier transform thereof, and

selecting N largest frequency components of the set of determined frequency components.

24. The method of claim 20, further comprising determining an interval, I, of the signal.

25. The method of claim 24, wherein the samples W are equally spaced in time over the interval I.

26. The method of claim 20, wherein an approximation of the signal x[n] is given by:

$$\hat{x}[n] = \sum_{k \in V} \left(real(X[k]) \cos\left(\frac{2\pi nk}{I}\right) - imag(X[k]) \sin\left(\frac{2\pi nk}{I}\right) \right)$$

where X[k] are frequency coefficients of x[n] for k=1, 2, …, N; and

I is the interval of the transient audio signal.

27. The method of claim 20, wherein step (b) includes:

determining an absolute value version $x_{abs}[n]$ of the signal $x[n]$; and

low-pass filtering the absolute value version $x_{abs}[n]$ to generate the approximate envelope $x_{env}[n]$.